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Japanese Patent

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**SEMICONDUCTOR DEVICE**

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## Specification

1. Title of the invention

SEMICONDUCTOR DEVICE

2. Claim

A semiconductor device, characterized by the fact that in a semiconductor device equipped with semiconductor elements being obtained by splitting a compound semiconductor wafer into an oblong shape, the corner parts of the oblong shape in the semiconductor elements are formed in a round shape.

3. Detailed explanation of the invention

(Purpose of the invention)

(Industrial application field)

The present invention pertains to a semiconductor device such as field-effect transistor (hereinafter, called FET) using a gallium arsenide GaAs semiconductor and monolithic microwave integrated circuit (hereinafter, called MMIC).

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<sup>1</sup> Numbers in the margin indicate pagination in the foreign text.

(Prior art)

FET, monolithic microwave integrated circuit (abbreviated to MMIC), etc., using a compound semiconductor such as GaAs have been formed as follows.

In other words, as shown in Figure 2(a), several pieces are simultaneously constituted on a disc-shaped semiconductor substrate called a wafer 1 by applying selective ion implantation, selective formation of various kinds of electrode materials and insulators, heat treatment, etc., and split along subscribed lines 2 by a diamond blade, etc., so that each semiconductor element 3 (Figure 2(b)) is formed.

The semiconductor elements 3 obtained in this manner show an oblong shape. Then, the semiconductor elements are usually mounted on a package or carrier plate by a solder or an adhesive, and electrodes of the semiconductor elements and external electrode terminals are connected by a gold wire or an aluminum wire and provided to practical uses. In the mounting work, as shown in Figure 4, the semiconductor elements 3 are handled by a vacuum pincette 4 in many cases.

On the other hand, since the above compound semiconductor such as GaAs was a relatively brittle material, when it contacted with the vacuum pincette 4 in its manufacturing processes, the corner part of the oblong shape was easily lost.

Figure 3 shows a semiconductor element 13 in which a deficient part 5 is generated in one corner part. In the semiconductor element 13 in which such a deficient part 5 is generated, the 1/2 degradation of the performances is usually observed, and it is anticipated that the degradation is advanced with time, even if it is not immediately detected. Thus, such a product is decided as an inferior product.

Therefore, in the above-mentioned conventional semiconductor elements with sharp corner parts, inferior products were frequently generated when mounting.

(Problems to be solved by the invention)

As mentioned above, in the conventional semiconductor device, its semiconductor elements have a acute angle at its four corner parts. As a result, when they were mounted using the vacuum pincette, deficiencies could not be avoided from being generated in the corners, and inferiorities were frequently generated when mounting.

The present invention removes the above-mentioned drawbacks, and its purpose is to provide a semiconductor device equipped with semiconductor elements that prevent the generation of deficiency when mounting using a vacuum pincette.

(Constitution of the invention)

(Means to solve the problems)

The semiconductor device of the present invention is characterized by the fact that in the semiconductor device equipped with semiconductor elements being obtained by splitting a compound semiconductor wafer into an oblong shape, the corner parts of the oblong shape in the semiconductor elements are formed in a round shape.

(Operation)

In the semiconductor device of the present invention, with the formation of four corner parts of the semiconductor elements in a round shape or at an obtuse angle, the deficiency due to the contact with the vacuum pincette is difficult to be caused.

Therefore, the generation of inferior products in the mounting process using the vacuum pincette can be prevented.

(Application example)

Next, an application example of the semiconductor device of the present invention is explained referring to the figures.

In a semiconductor element 23 shown in Figure 1(b), four corner parts are rounded, and in this example, the size of the round is constant, and the radius  $r$  of curvature is about  $1/6$  of the short side (a) of the semiconductor element and about  $1/12$  of the long side (b).

According to the above-mentioned constitution, since there is no acute angle in the contact part when handling the semiconductor elements by the vacuum pincette, the inferiority generation due to the cause of deficiency when mounting can be prevented.

In order to realize such a constitution, instead of the conventional split method using a diamond blade, a split method using an anisotropic selective etching may be adopted. At that time, it is important to form a mask being used in the selective etching in a shape in which the corner parts are rounded.

Specifically, as shown in Figure 1(a), a novolak group positive photoresist is spread on the surface of a wafer 1, and the photoresist other than the part corresponding to the remaining part as semiconductor elements is exposed by irradiating ultraviolet rays via a photomask and developed. The photoresist pattern is made to correspond to the shape in which four corner parts of the semiconductor elements are rounded, so that a pattern of photoresists 6 shown in Figure 1(a) can be formed.

Next, using the photoresists 6 as etching masks, the wafer is selectively etched with a reactive gas containing  $\text{BCl}_2$  and  $\text{Cl}_2$  and split, and the photoresists are dissolved and removed by an organic solvent, so that the semiconductor element 23 shown in Figure 1(b) can be obtained.

(Effects of the invention)

As mentioned above, according to the present invention, when handling by the pincette, the deficiency generation can be prevented in the semiconductor elements composed of a compound semiconductor, so that a semiconductor device that can prevent the inferiority generation in mounting the semiconductor elements on a package or carrier plate can be provided.

#### 4. Brief description of the figures

Figure 1(a) is a plan view for explaining a formation means of an application example of the semiconductor elements of the present invention. Figure 1(b) is an oblique view showing an application example of the semiconductor element of the present invention. Figure 2(a) is a plan view for explaining a formation means of conventional semiconductor elements. Figure 2(b) is an oblique view showing a conventional semiconductor element. Figure 3 is an oblique view for explaining a deficiency in the conventional semiconductor element. Figure 4 is an oblique view for explaining a semiconductor element state after being handled by a vacuum pincette.



- 1 Wafer
- 2 Scribed line
- 3, 13, 23 Semiconductor elements
- 4 Vacuum pincette
- 5 Deficient part

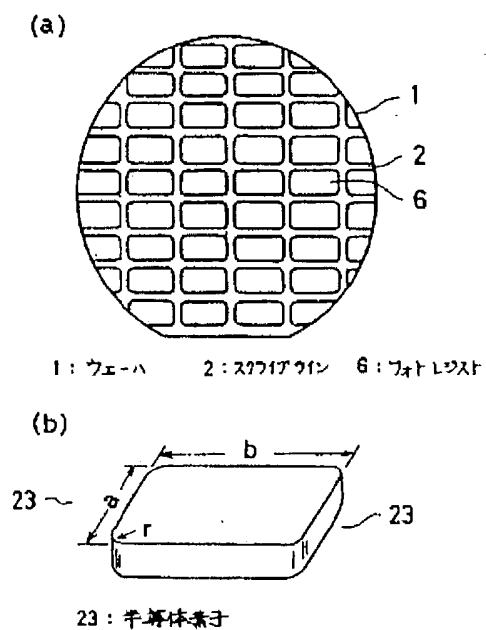


Figure 1:

- 1 Wafer
- 2 Scribed line
- 6 Photoresist
- 23 Semiconductor element

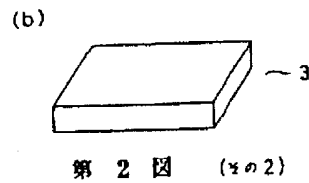
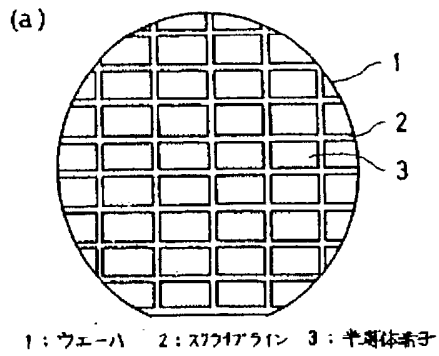


Figure 2:

- 1 Wafer
- 2 Scribed line
- 3 Semiconductor element

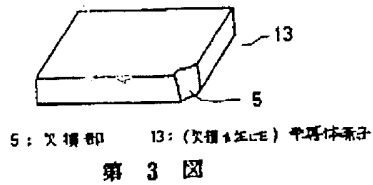
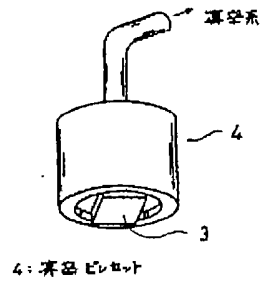


Figure 3:

- 5 Deficient part
- 13 Semiconductor element (in which deficiency is caused)



第 4 図

Figure 4:

4 Vacuum pincette

A. Vacuum system